UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF SILVER-COPPER NANOPARTICLES USING PHENOLIC COMPOUNDS EXTRACTED FROM PALM LEAVES AS THE REDUCING AGENT

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Silver-copper nanoparticles have various applications including antibacteria, catalyst, electrical conductor as well as silverware. The need to find a cost effective and less hazardous method to produce nanoparticles has lead to exploration of green synthesis using plant extract. Plants with high phenolic content are good sources of reducing agent, and palm leaves are one of them. The purpose of this research is to extract reducing agents from palm leaves through water-based extraction method and use the extract in the synthesis of silver-copper nanoparticles. The produced nanoparticles were characterized for its composition and structure. By implementing response surface methodology, a maximum total phenolic content of approximately 8 mg GAE/ g of dry palm leaves was obtained from extraction of palm leaves (dried at 70 °C) for 10 minutes at 70 °C. Synthesis of silver-copper nanoparticles using equal volume of silver nitrate and copper nitrate trihydrate, both at 1 mM, and 10 % of palm leaves extract has produced spherical and monodispersed silver-copper alloy with average size of 13.0 ± 0.3 nm. Changes in the concentration of metal salt solutions and palm leaves extract as well as the volume ratio of metal salt solutions significantly affect the composition of the produced nanoparticles with minimal effect on the particle size. It is hope that this study can contribute to the less expensive and environmentally benign production of nanoparticles.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Synthesis of bimetallic nanoparticles has become recent interest due to better properties and lower cost offered. Zhang *et al.* [1] reported that gold-silver nanoparticles exhibited better catalysis for aerobic glucose oxidation compared to gold nanoparticles. The gold-silver nanoparticles also exhibited better catalysis for reduction of benzyl chloride compared to silver nanoparticles as confirmed by Zhang *et al.* [2]. Venkatesan and Santhanalakshmi [3] through synthesis of gold-platinum nanoparticles again proved that bimetallic nanoparticles have enhanced catalytic activity. Li *et al.* [4] incorporated high-cost silver with copper and the resulting bimetallic nanoparticles successfully improved the electrical migration of ink in printing conductive lines. Moreover, Shin *et al.* [5] observed that alloying of silver with copper enhanced the structural stability of the bimetallic nanoparticles compared to pure silver or copper nanoparticles.

Bimetallic nanoparticles could exist either as alloy or core-shell, as illustrated in Figure 1.1. In synthesis of gold-silver nanoparticles, Ji *et al.* [6] found that low silver concentration lead to formation of alloy nanoparticles, while core-shell nanoparticles only formed at high silver concentration. Work by Sheny *et al.* [7] again proved that formation of gold-silver core-shell nanoparticles were favorable at high silver concentration. Zhang *et al.* [1] highlighted that core-shell was the best structure for catalyst since the catalytic sites were located on the surface of nanoparticles, while Valodkar *et al.* [8] stated that silver-copper alloy nanoparticles have effective antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. However, a density functional theory studied by Shin *et al.* [5] revealed that silver-copper alloy nanoparticles were less energetically stable than copper core-silver shell nanoparticles, but exhibited higher catalytic performance.